



SUMMER 1985

agave

Quarterly Magazine of the Desert Botanical Garden, Phoenix, Arizona

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A Treasury of Botanical Lore

by Muriel Freeman

The Richter Memorial Library recently completed a project to protect and preserve the Garden's collection of rare books by encasing them in individual custom-fitted acid-free boxes. This is how I came to work with and discover the romance of these books. I find them fascinating in various aspects: as interesting antique objects; as a treasury of botanical lore; as relics and witnesses of their times. There are some seventy separate volumes, the earliest being a "A nieuwe herball," published at London in 1578 as the English translation of Rembert Dodoens' (of the Netherlands) "Cruydeboeck" dated 1554.

With the printing press having just been introduced during the preceding century, books of the 16th century retained many features of the laboriously hand-wrought medieval manuscripts. Some are of heroic dimension, measuring as much as a hefty 14 by 20 inches, and would look at home in a monastic carrel. Bindings were sturdy and elegant in leather or vellum, some tooled with gold-leaf. Characteristic ridges across the spine resulted from pulling the cover taut over the cording which stitched the pages together. Print type was designed after the model of the neat "book hand" of the Middle Ages. Commentary was printed in the margins, and artistic embellishments included illuminated letters.

As the printing process offered opportunity for accurate reproduction of pictures and diagrams in scientific books, and as students of botany increasingly insisted upon actual observation of plants, woodcut illustrations came into lavish use. Engraved plates for frontispieces, portraits, coats of arms, maps, etc., also adorned these books. By the 18th century, exquisite hand tinting enhanced certain illustrations, and some sheets were intriguingly watermarked. Much in vogue during the 19th century, the by-then cloth and cardboard bindings and inside covers were decorated with papers in a distinctive oil-and-water look of multicolored swirls and bubbles.



Philip Miller's "Gardener's Dictionary," published in 1731 and regularly revised and enlarged thereafter, was not illustrated. However, between 1755 and 1760 he published "Figures of the Most Beautiful, Useful and Uncommon Plants Described in the Gardener's Dictionary."

Warped, scuffed and scarred bindings, water staining, brittle and browning page edges, inking which has run — and bookworm damage — are inevitable hallmarks of books of great age and long usage. The remarkably good condition of even the oldest among them testifies not only to the skilled craftsmanship of the early bookbinders and the enduring quality of their materials but to the care accorded by the select few who had access to and prized them as precious tomes of learning.

Various markings and inserts added by book owners or readers down through the ages are curiosities in themselves. There are handwritten notes, comments and observations. In the "Hortus elthamensis seu plantarum rariorum" of Johann Jakob Dillenius, an

anonymous someone has corrected plant names printed beneath picture plates in now-fading fine lettering to match. When, in the 250 years since its publication in London in 1732, might that have been done? And how about an inscription in another work, more than a hundred years ago, marveling that it was at that time 200 years old! Or "Jane Estham's Book 1791"? There are many samples of quaint and archaic handwriting and expressions. Bookplates affixed through the years might be considered an art form of their own.

The Desert Botanical Garden's copy of "The botanical works of the late George Engelmann" (Cambridge, Mass., 1887) happens to be the one which was autographed and sent to a Professor Planchon of the Jardin



Limited edition prints of John Miller's *Agave americana* were produced for the Garden. They are available at the Gift Shop.

Botanique at Montpellier, France, by Henry Shaw, the St. Louis benefactor of botanical studies who had funded this complete collection of his friend's botanical publications. ("Shaw's Garden" was the original name of the Missouri Botanical Garden, America's oldest botanical garden.) Increasing the sense of human interest is a postal card, which has been kept with the book, written sometime later (in 1888) by William Trelease, the eminent director of the Missouri Botanical Garden and the book's editor, requesting that Professor Blanchard's son retain the volume with the library of his "lamented father." (The stamps themselves must now be collector's items.)

A "bookmark" left in place some long ago day can turn out to be noteworthy in itself, as in Pierre Bulliard's "Flora Parisiensis" (1776): an 1856 Williams College announcement for an "expedition to the western coast of Florida, for the purpose of studying the natural history of the country ..." reminds us how far away that was in place as well as time.

Let us consider the primary function of these books — as repositories of botanical knowledge. The Renaissance books pick up where the ancients left off. "De historia plantarum" published in Amsterdam in 1694 contains the original Theophrastus (287? B.C.) text in Greek with Latin translation. In the 15th and 16th centuries, aided by the advent of printing, European physicians and botanists produced a number of herbals, based largely on Dioscorides (physician to Antony and Cleopatra) and to a varying extent on first-hand observation. The "Herball" of John Gerard, which was published in England in 1597 with text in English, borrowed heavily from another work which Dodoens had published in the Netherlands in 1583. It was illustrated for the most part with impressions from wood blocks which had been published at Frankfurt in 1590 but its style made it the most renowned of English herbals. While Latin continued in universal use as the language of scholarship for many years more, the vernacular had made strong inroads. By the time the 18th century was underway, great faith had developed in the ability of the

common man to educate himself by reading, hence, the popularity of encyclopedias in that period. The "Gardener's dictionary" by Philip Miller (1691-1771) appeared in London in 1754.

Global voyages of discovery had broadened horizons, and botanists were sailing with them and seeking new specimens far afield. Studies were compiled of flora of hitherto unknown lands, as evidenced in titles such as: "Histoire naturelle des Iles Canaries;" "Stapeliae novae: or, a collection of

These books survived natural disasters, revolutions and wars

several new species of that genus; discovered in the interior parts of Africa;" "Demonstration de las eficaces virtudes nuevamente descubiertas en las raices de dos plantas de Nueva Espana, especies de agave y de begonia;"* and the aforementioned "Nova plantarum ... Mexicanorum historia."

Plant study, previously motivated mainly by medicinal needs or the search for new and exotic "greens" — or even more to execute formal, geometric gardens — had, by the 18th century, taken on a spirit of scientific inquiry. The latter half of the century is represented with two great pioneers: Carolus Linnaeus in his "Species plantarum," Stockholm, 1762-63; and Augustin Pyrame de Candolle in his "Plantarum succulentarum historia," Paris, 1799, and, subsequently, his imposing work (completed by his son), the "Podromus systematis naturalis regni vegetabilis," Paris, 1824-1873. How impressive it is to hold in one's hands the actual original edition of classic works like these!

And, if we let our imagination place them in historical context, what might they tell us of their times? We can picture them down through the ages in the private libraries of noblemen, in the vast libraries of venerable universities,

*"Aloidaruym sive aloes murronato folio Americanae majoris";

in the inner sanctum of booksellers in the Old World and in the collections of wealthy connoisseurs. These books survived natural disasters, revolutions, wars, changes in taste and in personal fortunes — and the passage of time. We realize from flowery and flattering dedications to lordly patrons how dependent the author was on their encouragement, financial support and permission for his scholarly pursuits and production. Bulliard presented his "Flora Parisiensis" in 1776 "avec approbation, et privilege du Roi." That absolute monarch was Louis XVI, who less than twenty years later was to lose his throne and his head. In 1796, however, it was still appropriate for Francis Masson to humbly dedicate his "Stapeliae novae" to the King (of England)! In this case, it was Masson who lost his life. In 1805, in the service of the Royal Botanic Gardens, Kew, he froze to death while plant hunting in North America.

In the exciting era of the mid-1800's when the United States was expanding its frontiers and exploring new territories, surveys were commissioned for military, boundary, railroad and other purposes. With great foresight, artists and naturalists were also included in these parties, so that their published reports provided an authentic first glimpse and description of native plant life in its pristine setting. One such report to Congress, by the War Department, is duly bound with black cloth cover befitting a government document, but the front is emblazoned with a gilt image of the U.S. Explorer, the sternwheeler aboard which the expedition navigated the Colorado, and the back is embossed, as a patriotic flourish, with the American eagle, emblem of a proud young nation.

There are so many stories to be told by and about these books and their authors. This article gives but an inkling of the information, insights and delights held in store by the Garden's book collection.

Muriel Freeman, a Desert Botanical Garden Volunteer, devoted countless hours to the painstaking task of protecting these irreplaceable books. It became a labor of love that inspired her to write this article.

The mid-eighteenth century was a period of brilliant work by botanists, gardeners and artists who produced a flood of important botanical and horticultural books.

Philip Miller was once called "the prince of gardeners" by the Swedish botanist Carolus Linnaeus. At that time, a gardener was not just a person who trimmed and cleaned up the property. He served as horticulturist, researcher, director, and produced regular written and illustrated reports.

Foremost among Philip Miller's writing, was his monumental work, "The Gardener's Dictionary," which was first published in 1731. Scientific names of more than 600 plants, including the original descriptions of more than 300 plants, were first published by Philip Miller.

"The Gardener's Dictionary" was not illustrated, but between 1755 and 1760 Miller published "Figures of the Most Beautiful, Useful and Uncommon Plants Described in 'The Gardener's Dictionary'." The lavish work contained 300 hand-colored copper engravings by the best botanical artists that Miller could find.

Many of the plates conform to the 9x12 page size of volumes, but plate 222, *Agave americana*, is a twice folded insert page nearly 21 inches long.

John Miller, artist, was not related to Philip Miller, gardener and publisher. Born Johann Sebastian Muller, he emigrated to England in his youth from Nuremburg. As a botanical artist he made plates for Linnaeus and others and also wrote, illustrated, and published six books of his own.

The original *Agave americana* print owned by the Desert Botanical Garden Richter Library has become fragile and the two creases, where it was folded into the book, have developed brownish yellow discolorations that needed to be toned down when the print reproductions were made for the Garden. The paper used is close to the original in both color and texture and the colors in the prints almost exactly match the original colors.

A limited edition of these prints was produced for the Garden. A few framed and unframed prints from that printing are available in the Garden Gift Shop.

Utilization of the Mesquite

PROSOPIS. "Mesquite" (Mimosoideae)

Plants spiny shrubs or trees; leaves bipinnate, deciduous, with small glands between the paired leaflets; flowers small, perfect, numerous, in clusters, spikelike racemes, or sessile and in dense spikes; calyx 5-toothed; corollas regular, petals 5, distinct or sympetalous; stamens 10; pod indehiscent, or tardily dehiscent, curved, undulate or tightly coiled spirally; seeds few to many, hard smooth.

P. velutina Wooton "Velvet mesquite"

Description: Tree to 12 m tall with a rounded crown and lightly fissured brown bark; young twigs puberulent; spines axillary to petioles; primary pinnae 1 or 2 pairs, 3-8 cm long; total leaflets per leaf 8-20 pairs, 6-13 mm long, finely puberulent; flowers in dense spikelike racemes 5-12 cm long; petals 2-3 mm long; pods little, if any, constricted between seeds 10-25 cm long, 1-1.5 cm wide, falcate. Flowering period from April-August.

Distribution: Desert washes and plains; from west-central Arizona to western Texas, southward into northern Mexico.

P. glandulosa Torr. var. *torreyana* (L. Benson) M.C. Johnston "Honey mesquite, western honey mesquite"

Description: similar to *P. velutina* but having glabrate foliage and leaflets commonly longer than 15 cm.

Distribution: Desert slopes and arroyos; Colorado Desert to southern Nevada, southward into Arizona, southern Texas, and northern Nevada.

P. pubescens Benth. "Tornillo, Screwbean mesquite"

Description: Openly branching tree to 10 m with thin flaky bark, slender twigs, and stipular spines joined together at base, 1-2 cm long, and puberulent herbage; primary pinnae 1 pair; leaflets 4-9 pairs, 6-10 mm long; inflorescence a dense spike, 2-5 cm long; pods tightly coiled spirally, sessile, 5-7 mm in diameter, 3-6 mm long; seeds 1-2 mm long. Flowering period from April-June.

Distribution: Streambanks, bottomlands, and around waterholes, Mohave and Colorado Deserts eastward to southern Utah and southward into Texas and northern Mexico.

With the exception of Felger and Moser (1971, 1976) and Felger and Nabhan (1976) most of the literature on the utilization of mesquite cited it as *Prosopis juliflora* (SW.) DC. Since this species does not extend up into the United States, the misapplied name *P. juliflora* for U.S. plants actually refers to either *P. glandulosa* Torr. var. *torreyana* (Benson) M.C. Johnston or *P. velutina* Woot. The reader is referred to Johnston (1962) for name and distribution revisions.

by Wendy C. Hodgson,
Herbarium Curator

From early prehistoric times to the present, *Prosopis velutina* was extensively utilized in southwestern North America (Felger and Nabhan, 1976). It was considered the "staple of life" to the Mohave, Yuma, Cocopa, and Coahuilla Indians (Barrows, 1900) and was "invaluable" to the Mexicans (Havard, 1895). The mesquite was a very important food staple to the Pima Indians. In years when their crops failed, the fruits of the saguaro (*Carnegiea gigantea* (Engelm.) Britt & Rose) and mesquite were the most abundant and accessible. The Papago Indians sometimes received mesquite beans and meal in trade with the Pimas. For the Apache Indians, the mesquite was, and still is to a lesser degree, an important source of food (Castetter and Bell, 1937, cited as *P. chilensis*).

The Coahuilla Indians of southern California gathered the pods in large quantities, dried them, and packed them away in their "graneries" (Barrows, 1900). The pods were later pounded up whole in a wooden mortar (sometimes a mesquite log with the hollow burned out) and the resulting meal was placed in earthenware and soaked thoroughly. It was either eaten in this form or allowed to ferment so as to improve the taste. Sometimes the mass was rolled into compact balls and carried for food on a journey.

Some Indian tribes ground the pods on stone mortars or in holes in the ground (one tribe is said to have ground the pods in hollows in the earth and mixed soil with the meal to "sweeten the flour") (Palmer, 1878). To make bread, the meal was added, alternating with a few sprinkles of water, to a "bread tray" until the tray was filled. It was then set out in the sun until it turned solid. It was considered very sweet, and as long as this bread lasted, "the Indians keep fat" (Palmer, 1878).

The Pima Indians often boiled the dried, pounded pods with water until they became soft. After the water was squeezed out, the pulpy substance remaining was molded into cakes and then baked in hot ashes (Castetter and Bell, 1937). According to Russell (1908),

the Pimas used mesquite, corn, and wheat flour as a mush, fried suet, or made into tortillas or loaves which were baked in ashes. Saunders (1948) reported that the Pimas used mesquite meal as a makeshift sugar. A kind of beer was made by them also, prepared by mixing mesquite flour and water and allowing it to ferment (Palmer, 1871, Havard, 1896).

Apparently the seeds were never extensively used because of the difficulty in separating the true seed from the inedible endocarp, although certain prehistoric peoples of Sonora devised "gyratory crushers" which could break open the endocarp and

A kind of beer was made by mixing mesquite flour and water and allowing it to ferment

free the seed (Felger and Nabhan, 1976). Some tribes did take the seeds from the pulp and did grind them into flour which was made into pinole or bread (Palmer, 1878). The Coahuilla Indians furnished themselves with a sweetish "Lemon-tasting" drink made by pouring warm water over the seeds (Saunders, 1948).

The pods are more easily harvested than most other fruits because the pods fall to the ground when ripe (Felger and Moser, 1971). They do not split apart at maturity and thus do not lose the seeds and pulp. The pods are gathered quickly and readily processed after they are parched or heated. This will help control the common bruchid beetle ("bean-weevil"), of the genus *Bruchus* which deposits its eggs in the pods. The Indians often ignored the pest, incorporating the animal matter into the meal (Felger and Moser, 1971).

As a result of recent work by Felger and Moser (1971) the status of *P. glandulosa* var. *torreyana* ("honey mesquite") among the Seri Indians has been brought to light. The Seri Indians utilize this mesquite species only. Large stands occur in aggregated masses along the coastal plains and line the

channels and floodplains of Baja California, Mexico.

To the Seris, the honey mesquite is one of the most important native resources, despite the fact that the utilization of the plant as a food source is less practiced today (Felger and Moser, 1971). Eight stages of the growth of the fruit are recognized by them, these ranging from the youngest stage, when the pods are less than one inch long, to the mature pod that has fallen to the ground. Young pods are tied into small bundles and cooked with meat. The older, but still green pods picked from the tree are mashed in a mortar formed in bedrock or hard earth and is then cooked in a pot. Pods that have fallen from the tree are the most commonly used stage of the fruit. One method of preparation and eating is to pound the pods in the mortar, then chew them, swallowing the juice and discarding the pulp. The more common method is to toast the pods before pounding. The dry pods are piled on a clear area of the ground that was previously burned over and the charcoals cleared. At the same time four piles of sand are placed around the area, and fires are burned on each pile to heat the sand. The pods are then sprinkled with the hot sand, the heat from the hot earth and sand toasting them (and killing the *Bruchus* beetle). After the pods are toasted they are pounded by the women, adding more pods as they are mashed until they are all pounded. Mashed pods or pulp are put in a basket and winnowed gently by tapping the basket against the pestle (the instrument used for pounding in the mortar). This separates out the flour, which comes from the mesocarp, from the seeds, pieces of fiber and exocarp. After it is winnowed again, the pure flour is stored in a jug. Rolls and cakes are made by putting the flour into a large basket, mixing it with water, and then kneading it into a dough. This dough is shaped into rolls and cakes, and then dried immediately.

The seeds and pieces of fiber that were previously separated out are saved to make more fiber (Felger and Moser, 1971). The seeds plus surrounding endocarp are separated out from the rest of the pod and are



Mesquite pods are more easily harvested than other fruits because the pods fall to the ground when ripe. Illustration by Wendy C. Hodgson

pounded again to free the seed from the endocarp. This is then winnowed to separate the seed from the endocarp. The seeds are ground on a grinding stone, the resultant flour then mixed with water and drunk.

The fibers of the pods are chewed for the sweet taste (Felger and Moser, 1971). Sometimes a drink is made by putting the endocarp and seed mixture that was saved into a jug of water and allowed to let stand until the water becomes sweet. By letting it stand for several years (!) a fermented drink was obtained. Sometimes the Seris place the dry pods in a jug of water and cook them. The pods are then chewed, the inedible parts spit out and the broth drunk.

The screwbean mesquite, *P. pubescens* Benth., is not as widespread as the honey or velvet mesquites but, where it occurs, it was utilized extensively. They were important to the Yuma, Mohave, and Pima Indians (Barrows, 1900; Castetter and Bell, 1937; and Kearney, Peebles, and collaborators, 1960).

The pods of the screwbean mesquite have a more bitter taste when fresh and are considered unsuited for use until quite mature. However, when the pods are ripe and void of any moisture, they are considered sweeter than those of the honey or velvet mesquites (Barrows, 1900; Castetter and Bell, 1937). The pods were utilized in much the same way as the other mesquites

The flowers are a source of an excellent honey, ranked as the best in Arizona

described. An interesting method of preparation was employed by the Maricopa, Pima, Mohave, and Yuman Indians who "cooked" the pods in the ground, the different tribe's procedures varying somewhat. Pits were dug and lined with arrowweed (*Tessaria sericea* (Nutt.) Shinnery). The pods were placed

in layers in the pit, sometimes alternating with cocklebur (*Xanthium* sp.) leaves. The whole was covered with soil and left to stand for three or four days (Pimas) to a month (Mohave and Yumans). The pods turned brown and very sweet (Castetter and Bell, 1937; Balls, 1970).

The seeds have a protein content of 39.9%

Felger and Moser (1976) point out that, although it took much time and effort to prepare mesquite flour, it was well worth the trouble as the seeds have a protein content of 39.9 percent (Jones and Earle, 1966). Based on the analysis by Walton (1925), Greenhouse (1979) calculated that the pod material (100 g edible portion) contains 12.4 percent water, 6.7 g protein, 1.5 g fat, 47.9 g carbohydrate, 33.1 g fiber, and 232 calories. The embryos of the seeds (100 g edible portion) contain 6.6 percent water, 65.2 g protein, 6.8 g fat, 11.6 g carbohydrate, 1.9 g fiber, and 368 calories. Ross (1941) found mesquite beans (100 g edible portion) to contain 7.5 percent water, 13.8 g protein, 2.8 g fat, 67 g carbohydrate, 469 g calcium, and 348 calories.

The flowers of *P. velutina* were sometimes eaten by the Pima Indians by stripping them from the inflorescence axis with their teeth (Russell, 1908). The flowers are a source of an excellent honey, ranked as best in Arizona (Kearney, Peebles, and collaborators, 1960; and Niethammer, 1974).

The Pimans also used the inner bark as a substitute for rennet and used the gum in making candy. This gum is exuded from cuts in the trunk and is similar to gum arabic. It is reported to be good chewed and was used as a glue. By boiling the gum, a black dye was obtained. This dye was used by various Indians to decorate their pottery (Saunders, 1948; Kearney, Peebles, and

collaborators, 1960). Another use by the Indians was to use the boiled gum as a type of hair cleaner and conditioner. The gum was mixed with mud and, as a paste, was plastered all over the men's and women's sun-damaged hair and left overnight. To finish the treatment, the hair had to be washed off in three tubs of water before sunrise the next morning (Niethammer, 1974). The hair was left "not only jet black, but the unwelcome visitors that previously lodged therein were all dead" (Palmer, 1878).

The Seri children chewed the rather bitter gum of *P. glandulosa* var. *torreyana*, then spit it out and drank some water which, to them, tasted sweet as a result (Felger and Moser, 1971).

Indians used the boiled gum as a type of hair cleaner and conditioner

Mesquite wood was most important to the desert Indians, being used as poles for homes and for furniture. It is considered one of the best sources of firewood, second only to ironwood (*Olneya tesota* Gray) as it burns slowly and gives off considerable heat (Kearney, Peebles, and collaborators, 1960; Balls, 1970).

Unfortunately, mesquite is considered a serious pest in overgrazed grasslands where it increases rapidly (Kearney, Peebles, and collaborators, 1960). The agronomic potential of mesquite has been recognized by only a few and it is hoped that it will play a major role in the future as an important food plant.

Note: Ruth Greenhouse, Desert Botanical Garden research associate, will conduct a workshop on the many uses of the mesquite bean on Wednesday, October 23 from 9:00 a.m. till noon in Webster Auditorium. For information and registration call the Education Department, 941-1225.

A Status Review: The Living Collection At The Desert Botanical Garden

by Victor Gass, Curator

Living collections management is a matter of knowing where we are going based on where we have been and where we are now. This may be an oversimplification, but over the past four years the living collection department at the Desert Botanical Garden has been reviewing the Garden's plant records to find answers to some "simple" questions. Our ability to do this came about only after we converted to a computerized records system and completed a mapping inventory of the collections.

Simply stated, a status review is a statistical look at some of the basic items by which we can monitor overall trends, performance and collections activities. The basic measurable values provide answers to these routinely asked questions:

- How many plants do you have?
- How many accessions do you have?

A second level of more specific questions might be grouped:

- How many and which taxa do you have? (Do you have a certain plant?)
- How many and which families do you have? (Do you have a certain family?)

A third level of questions, in greater detail, might ask:

- Where are the plants in your collection?
- Where did you get these plants?

The fourth level, probably the most difficult to fully develop, may answer these questions:

- Why do we have this particular plant?
- Is this particular plant fulfilling its purpose; is there a good reason to keep this plant in the space it now occupies?

Now we can look at each question and provide some answers. However, as you will see, one answer may lead to many others as well as to new questions. We have obtained these answers from three primary reports: Basic Data By Accession; Basic Data By Family; and Basic Data By Bed (location).

From 1939 until 1981, the Desert Botanical Garden used a ledger book/card file system of record keeping. Based solely on those records, it would appear that roughly 33% of the plants in the living collection and 40%

of the accessions are either missing or unaccounted for. In fact, this is not the case at all. Rather, it is a reflection of an imbalance in the old records which is now apparent in our computerized system. These figures are coming into balance as the merging of files is completed and new data is entered from the inventories being conducted.

Past collection records were maintained as accurately as possible within the given circumstances. During that period there was no method by which an overall review of the records could be easily accomplished. The computer has eliminated the tedious, labor-intensive effort needed to analyze the masses of data involved. Labor is still required to obtain the data, but the time involved in multiple or repetitive reviews is greatly reduced. This factor makes inventory and appraisal much more cost effective.

It is now possible to prepare an overview of the Garden as a whole, from 1939 to the present. The continuum of this growth is now readily apparent and we are able to take a critical look at the present and plan for the future. Once a luxury we could not afford, this analysis is now a necessity.

The first step is to clean up the records. This brings us back to the systematic review of the collection described at the beginning of this article.

Our systematic review to verify each plant in the collection began in 1981. Most plants or accessions in the "unknown" category probably died without the records being updated. We know this because they do not show up on the mapping inventory. Sometimes the "missing" plants have been found and the records are updated. Soon we will reach the point where the status of all the plants which now exist in the accession system is known.

This brings us back to that fourth, most difficult level of questions:

- Why do we have this particular plant?
- Is the plant fulfilling its purpose; should we keep it in the collection?

In many cases, the reasons why a particular plant was accessioned are unknown. The decision on the disposition of the plant must be based on evaluation as a factor of literature, reviews of the plant's value and its performance at its location.

Subjective judgements may influence this decision. Therefore, a guideline for objective evaluation against specific criteria is needed. Developing a checklist is a method of organizing one's thinking. And using such a checklist should eliminate otherwise confusing, subjective ideas. The Desert Botanical Garden is just beginning this evaluation procedure and we expect to make many changes before the process is completed.

In general, the points of analysis in an evaluation of a plant already in the collection may include:

1. Meeting overall collections criteria
2. Health, safety
3. Documentation: wild origin, field collected, common origin
4. Rare, threatened or endangered status
5. Present use in research; economic value
6. Representation for botanical diversity
7. Historical value, visual value
8. Horticultural, ornamental merit, design function
9. Interpretation, educational value
10. Special collections, geographic collections

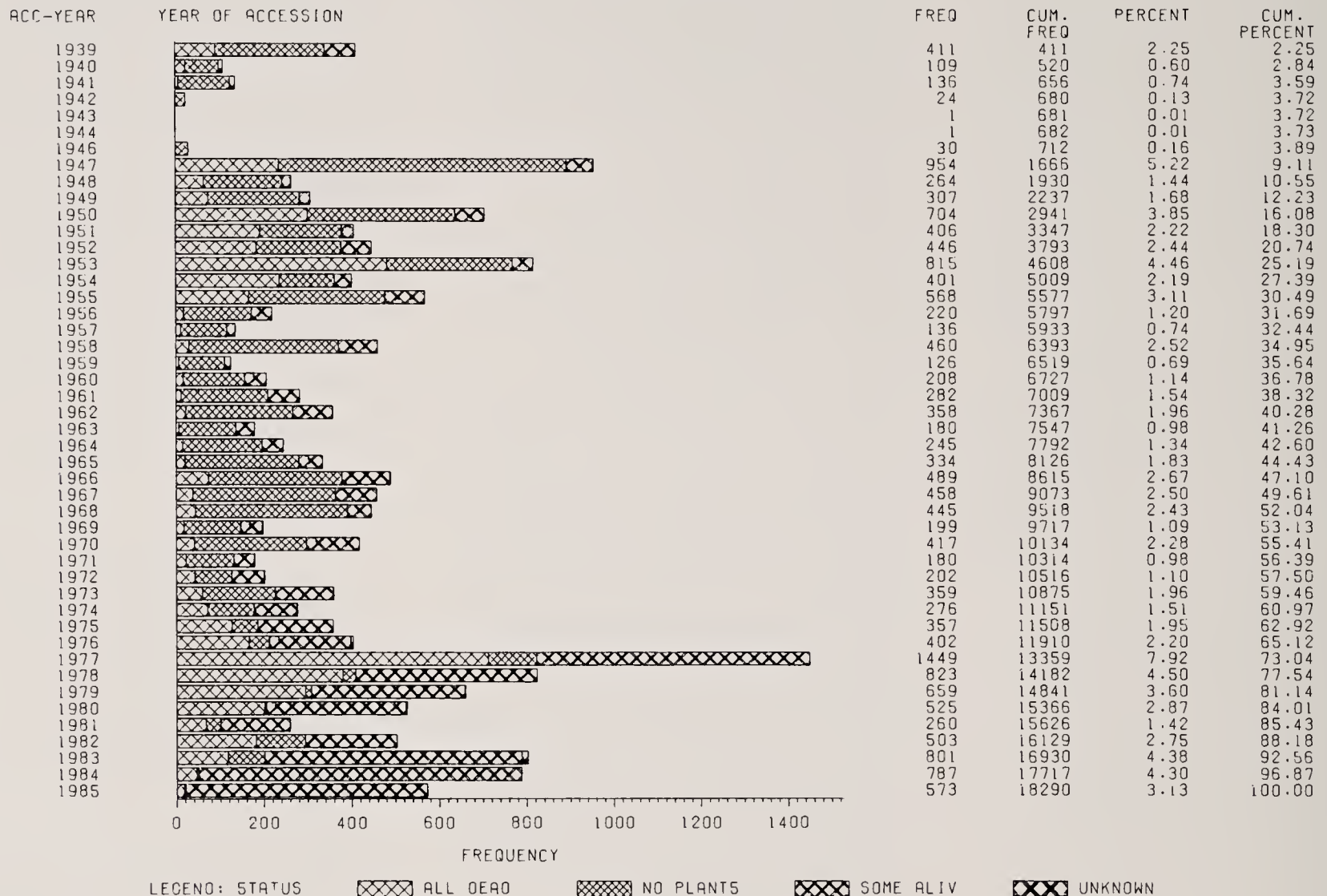
A plant would be kept if it meets one or more of these criteria, and certainly, these factors are not cast in stone. There must always be room for the aesthetically pleasing plant whose reason for being is just to be beautiful and to be enjoyed by people. However, the basis will be recorded so that the information will continue to be part of the decision-making process.

The Desert Botanical Garden is much more than a display garden. The living collection should reflect a balance between the display/aesthetic needs, education/research and preservation needs. It is critical that this be defined at the outset, and we are still striving to achieve this equilibrium. The numerical guidelines are being established so that quantities of plants do not overwhelm either the quality of the Garden or the care that must be given.

The current status review is the first of many. The numbers will change, as will the priorities for collection. The next review may be vastly different because there will be fewer unknowns. We can build on the strengths we have found in the collection, drawing on the knowledge and understanding of where we have been.

DESERT BOTANICAL GARDEN

STATUS OF COLLECTIONS
ACCESSIONS PER YEAR



A. Status of Collections (Accessions per year). This graph shows the number of accessions per year (FREQ); the total number of accessions (CUM FREQ); the percent of total accessions in each year; and the cumulative percent of accessions.

Legend:

ALL DEAD = no living plants from accession
NO PLANTS = no plants, data never recorded for accession
SOME ALIV = Accession has some living plants
UNKNOWN = Accession has plants listed as dead and others of unknown status

A1. This chart corresponds to Graph A. It shows the actual quantities for each status category for the past seven years; the percent of status category in each year; actual total and percent of each status category; and total accessions to date. Note that 39.56% (7,232) of all accessions do not have corresponding plant data at this time. (For those of you with computers, this graph and chart were both produced at a cost of \$3.79 using approximately 19 seconds of CPU time (72¢) and 1588K memory used. Security backup procedures used \$2.12 of the total cost. Arizona State University Academic Computing.)

DESERT BOTANICAL GARDEN STATUS OF COLLECTIONS ACCESSIONS PER YEAR

TABLE OF ACC_YEAR BY STATUS

ACC_YEAR	YEAR OF ACCESSION	STATUS				
FREQUENCY	PERCENT	ALL DEAD	NO PLANT	SOME ALI	UNKNOWN	TOTAL
ROW PCT	COL PCT		S	V		
1979		295 1.61 44.76 5.93	13 0.07 1.97 0.18	350 1.91 53.11 5.70	1 0.01 0.15 3.33	659 3.60
1980		202 1.10 38.48 4.06	3 0.02 0.57 0.04	319 1.74 60.76 5.20	1 0.01 0.19 3.33	525 2.87
1981		69 0.38 26.54 1.39	32 0.17 12.31 0.45	159 0.87 61.15 2.59	0 0.00 0.00 0.00	260 1.42
1982		182 1.00 36.18 3.66	113 0.62 22.47 1.58	208 1.14 41.35 3.39	0 0.00 0.00 0.00	503 2.75
1983		119 0.65 14.86 2.39	83 0.45 10.36 1.16	586 3.20 73.16 9.55	13 0.07 1.62 43.33	801 4.38
1984		48 0.26 6.10 0.96	3 0.02 0.38 0.04	736 4.02 93.52 12.00	0 0.00 0.00 0.00	787 4.30
1985		19 0.10 3.32 0.38	4 0.02 0.70 0.06	550 3.01 95.99 8.96	0 0.00 0.00 0.00	573 3.13
TOTAL		4978 27.22	7147 39.08	6135 33.54	30 0.16	18290 100.00

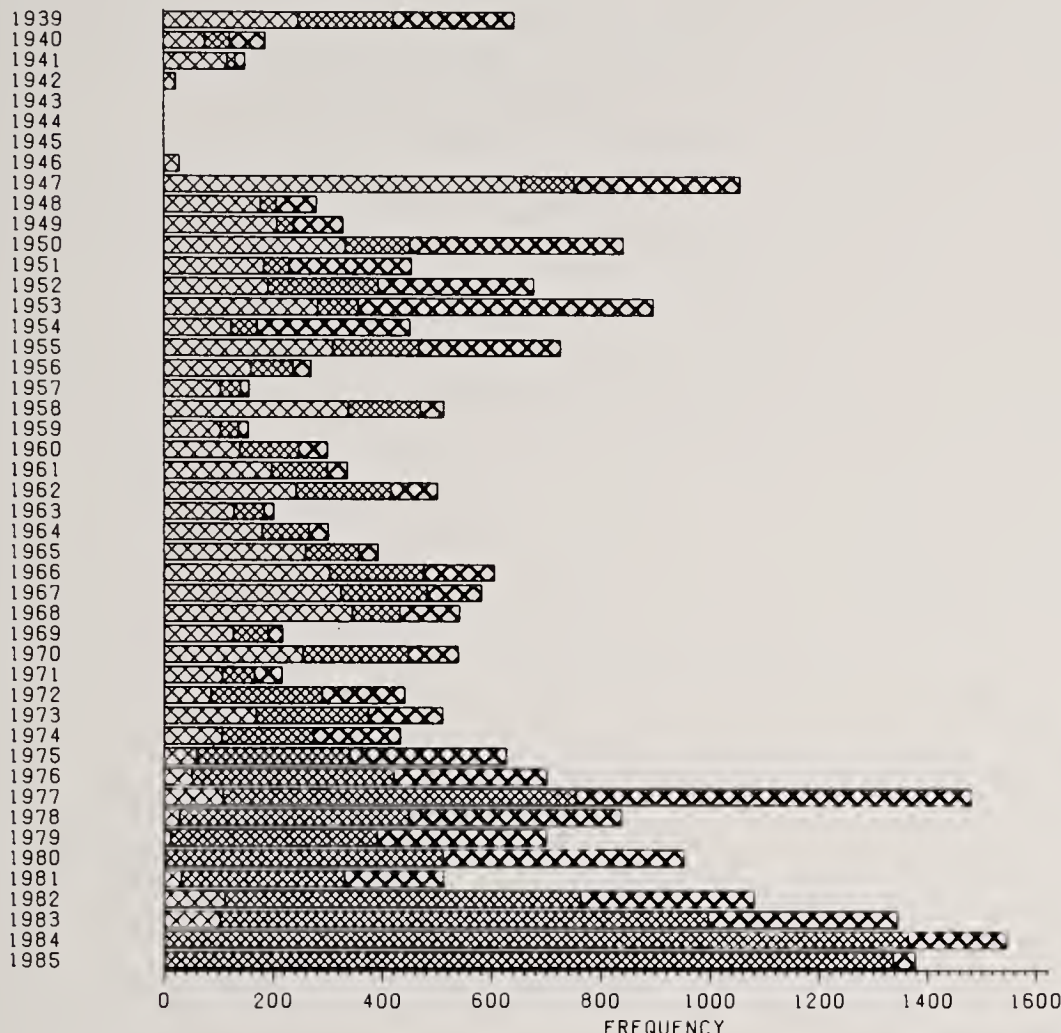
DESERT BOTANICAL GARDEN

STATUS OF COLLECTIONS
REPORT NUMBER 16A
PLANT STATUS BY YEAR

MIPOINT
ACC-YEAR

YEAR OF ACCESSION

FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
643	643	2.56	2.56
187	830	0.74	3.30
150	980	0.60	3.90
24	1004	0.10	3.99
1	1005	0.00	4.00
1	1006	0.00	4.00
0	1006	0.00	4.00
30	1036	0.12	4.12
1056	2092	4.20	8.32
281	2373	1.12	9.44
330	2703	1.31	10.75
842	3545	3.35	14.10
456	4001	1.81	15.91
679	4680	2.70	18.61
898	5578	3.57	22.18
452	6030	1.80	23.98
728	6758	2.89	26.87
271	7029	1.08	27.95
157	7186	0.62	28.58
514	7700	2.04	30.62
156	7856	0.62	31.24
301	8157	1.20	32.44
337	8494	1.34	33.78
502	8996	2.00	35.77
202	9198	0.80	36.58
303	9501	1.20	37.78
394	9895	1.57	39.35
606	10501	2.41	41.76
582	11083	2.31	44.07
543	11626	2.16	46.23
219	11845	0.87	47.10
540	12385	2.15	49.25
218	12603	0.87	50.12
442	13045	1.76	51.87
511	13556	2.03	53.91
434	13990	1.73	55.63
628	14618	2.50	58.13
701	15319	2.79	60.92
1481	16800	5.89	66.81
837	17637	3.33	70.14
700	18337	2.78	72.92
953	19290	3.79	76.71
512	19802	2.04	78.74
1080	20882	4.29	83.04
1344	22226	5.34	88.38
1545	23771	6.14	94.53
1376	25147	5.47	100.00



LEGEND: DEAD N Y

DESERT BOTANICAL GARDEN STATUS OF COLLECTIONS REPORT NUMBER 16A PLANT STATUS BY YEAR

TABLE OF ACC_YEAR BY DEAD

ACC_YEAR YEAR OF ACCESSION DEAD IS THE PLANT DEAD?

FREQUENCY PERCENT ROW PCT COL PCT	N	Y	TOTAL
1979	14 0.05 2.00 0.19	379 1.49 54.14 3.61	307 1.21 43.86 3.95
1980	4 0.02 0.42 0.06	509 2.00 53.41 4.85	440 1.73 46.17 5.67
1981	32 0.13 6.25 0.44	301 1.18 58.79 2.87	179 0.70 34.96 2.31
1982	113 0.44 10.46 1.57	651 2.56 60.28 6.20	316 1.24 29.26 4.07
1983	104 0.41 7.74 1.44	893 3.51 66.44 8.50	347 1.36 25.82 4.47
1984	3 0.01 0.19 0.04	1362 5.35 88.16 12.97	180 0.71 11.65 2.32
1985	4 0.02 0.29 0.06	1334 5.24 96.95 12.70	38 0.15 2.76 0.49
TOTAL	7208 28.29	10504 41.23	7764 30.48
			25476 100.00

B. Status of Collections (Plant status by accession-year) This graph shows the number of plants accessioned per year (FREQ); the total number of plants (CUM FREQ); percent of total plants accessioned in each year; and cumulative percent of plants accessioned. In the legend at bottom, N means the plant is alive; Y means the plant is dead.

B1. This chart corresponds to Graph B. It shows the actual quantities for each category for the past seven years; the percent of each category of each year; the total frequency and percent for each category; and total plants (probable) to date. Note that 28.28% (7,203) of all plants accessioned do not have a recorded status at this time. (This graph and chart were produced at a cost of \$1.97 using approximately 12 seconds CPU time (49c) and 1580K memory used. Security backup procedures used 94c of the total cost.)

Desert Vegetable Gardening

by Judy L. Mielke,
Staff Horticulturist

Vegetable gardening in the desert: it would seem that this is a contradictory statement. After all, a hot, dry climate and harsh soils can hardly be expected to produce crisp, fresh vegetables like lettuce, tomatoes or carrots. With care and planning however, the home gardener can reap a bountiful harvest.

September is prime time for planting many vegetables. At our own vegetable plot in the John H. Rhuart Demonstration Garden we'll be sowing seed of bean, beet, carrot, chard, corn, kohlrabi, endive, lettuce, onion, pea, radish and spinach, and planting broccoli, brussels sprouts, cabbage, cauliflower and tomato plants raised from seed in our propagation greenhouses. You can get started on your garden and enjoy your own home grown vegetables.

Soil Preparation

The soil is the foundation of the garden, and care should be taken to prepare it for planting. Desert soils (called aridisols) are typically alkaline, light-colored, and have small amounts of organic matter. These characteristics are not conducive to vegetable growing, and must be altered.

Alkalinity (or salinity) is indicated by a high pH number. On the pH scale of 0 to 14, with zero being very acid, 7 indicating neutral, and 14 being very alkaline, our soils are typically between 7 and 8. This condition can be improved by adding soil sulfur at a rate of three pounds per 100 square feet of garden, or agricultural gypsum at two pounds for every 100 square feet.

In contrast to the usual image of deserts with drifting sand, our desert soil is often heavy and compacted. Adding organic matter will help improve the water and nutrient holding capacity of the soil. It will also lower the pH, aid fertility, and make the soil more loose, friable and easy to work. Manure, peat moss, grass clippings, hay, leaves, or any other type of plant debris should be spread at a depth of 2-3 inches over the entire garden and worked in two weeks before planting. Sand can loosen compacted soil, but should be used



For the 10'x30' vegetable plot in the Demonstration Garden we built a raised bed and added topsoil. Judy's summer crop includes watermelon, tomatoes, squash, peppers, onions, eggplant, parsley and herbs.

with restraint. Soils that drain too fast don't retain sufficient water.

Fertilizer

The nutrients needed for proper plant growth are often not available in desert soils. A fertilizer containing nitrogen and phosphorus should be applied before planting, and nitrogen added again

during the growing season. Some fertilizers also include potassium, but this is already plentiful in desert soils. However, iron is another element that needs replenishing. It can be added at the beginning of the season, and again as needed if the plants show signs of iron chlorosis (yellowing leaves with

green veins).

Fertilizer, compost and any other soil amendments should be thoroughly mixed with the soil, then watered in. It is a good idea to turn the soil again in a week or two if the garden is not to be planted immediately.

If the soil of the proposed garden site is hopelessly shallow or rocky, it may be best to build raised beds and purchase topsoil. This was the solution we opted for in the Demonstration Garden, as our site was underlaid by a granite outcropping.

Choose Adapted Varieties

Most vegetables can be grown in the desert, but some do better than others. The same is true for individual varieties. For example, the large, beefsteak-type tomatoes generally don't perform as well as the smaller cherry-type tomatoes. It is important to plant varieties that are adapted for low desert gardens. The chart lists several recommended varieties of each vegetable.

Planting Dates

One of the most confusing aspects of desert gardening for temperate-climate, "plant everything in the spring" gardeners is knowing the proper time to plant. Although some crops, such as radishes, can be grown nearly year-round, most vegetables can be classed either "cool season" or "warm season." Cool season crops are planted in the fall, to grow and mature before warm weather arrives. This group includes leafy and root crops (lettuce, spinach, carrots, beets), cole crops (broccoli, brussels sprouts, cauliflower, kohlrabi, kale, mustard greens, cabbage), and peas. Spring is the time to plant warm season crops, which grow through the summer until frost. Warm season crops are generally ones that form fruits: melons, squash, tomatoes, peppers, corn, beans, cucumbers, okra, eggplant. More specific planting times are indicated on the chart.

Watering

Watering, an essential activity in any vegetable garden, is even more critical in desert gardens subjected to high temperatures, intense sunlight, and drying winds. The best watering method

is one that most closely meets the individual gardener's needs. We have chosen a drip irrigation system for our vegetable garden.

Drip irrigation is the slow, steady application of water directly to the plant's roots, via plastic tubing. The initial cost is relatively high (about \$100 for a 1000 square foot garden), but drip irrigation saves water (and therefore money,) labor, and results in better plant growth because of the direct, even supply of water to roots. The drip tubing should last several years.

The Demonstration Garden vegetables are watered mostly by soaker tubing (tubing with tiny holes evenly spaced along the length of it) and emitters on the ends of thin "spaghetti" tubing, which are placed at the base of the herbs and other widely-spaced plants.

Furrow irrigation is simple and inexpensive but requires time to move hoses and watch for overflow. Seeds or plants are placed on the sides of the furrows to avoid damaging salt buildup. Production area of a furrow-irrigated garden is reduced by the space taken up by the furrows.

Maintenance

A gardener's work is far from over once the seeds are sown or the plants planted, but regular maintenance can keep gardening chores to a minimum. As the old saying goes, "an ounce of prevention is worth a pound of cure," or put differently, "one weed pulled before it goes to seed prevents millions of little weeds."

Mulching is a wise practice with several benefits: weed control, decreased water evaporation, cooler soil temperatures, and, if organic mulches are used, nutrients are added and the soil structure improves. Mulching materials can include straw, grass clippings, black plastic, and even newspaper.

Some crops, such as carrots and beets, will benefit from thinning. Others, tomatoes and peas for example, need support and trellising to grow their best.

A close watch should be kept on the plants for signs of insect damage or disease. If an infestation is dealt with immediately it can often be eliminated by hand-picking the insects or with

soap and water spray, avoiding a long battle with insecticides. Diseased plants should be removed to avoid spreading the problem.

The Harvest

Knowing when vegetables are ideal for harvest is as important as knowing how to grow them. This skill can take some time and experience to acquire, since the optimal degree of maturity differs between vegetables, and even varies with the intended use of the vegetable. For example, beets can be harvested when young to utilize the tops for greens, or allowed to mature for the root to be used. Some crops, such as corn or peas, are best when picked before they are fully mature, while tomatoes and watermelon are tastiest when allowed to ripen thoroughly.

The hours of effort put into a vegetable garden pay off at harvest time. A bonus of home-grown produce is its freshness and good flavor, often superior to the grocery store's fare.

A fresh, abundant harvest of vegetables is but one of the benefits of gardening. Relaxation, exercise, and a sense of accomplishment also come from tending a garden. Right now is a good time to start enjoying those benefits.



Judy Mielke is a horticulturist on the Desert Botanical Garden staff. She will be teaching a 2-session class on vegetable gardening on September 19 and 26 from 7:00 till 9:00 p.m. To register, call the Education Department.

Recommended Varieties For Desert Gardening.

Bean: Lima Burpee's Improved Fordhook 242 Henderson's Early Thorogreen Bean: Snap Bountiful Blue Lake Cherokee Wax Greencrop Harvester Poyalty Purple Pod Stringless Green Pod Tendergreen Topcrop Kentucky Wonder Beet Burpee's Golden Detroit Dark Red Early Wonder Green Top Bunching Lutz Green Leaf Ruby Queen Broccoli Green Duke Ital. Green Sprouting Premium Crop Spartan Early Waltham 29 Brussels Sprouts Jade Cross Long Island Improved Cabbage Copenhagen Market Danish Ballhead Ear. Jersey Wakefield Golden Acre Prem. Late Flat Dutch Red Acre	Cabbage: Chinese Michihli Wong Bok Cantaloupe Ambrosia Golden Beauty Casaba Crenshw Hale's Best Harper Hybrid Honeydew Rocky Ford Saticoy Carrot Danvers Half Long Gold Pak Imperator Nantes Red Cored Chantenay Cauliflower Purple Head Self Blanche Snowball Celery 52-70 Chard Fordhook Giant Large White Ribbed Lucullus Rhubarb Collard Vates Georgia Corn: Sweet Early Xtra Sweet Golden Cross Bantam Golden Beauty Honey and Cream Ill. Chief Xtra Sweet Jubilee Merit	Seneca Chief Silver Queen Cucumber Armenian Yard Long Ashley Lemon Liberty Marketmore 70 Marketmore 76 Poinsett 76 SMR 58 Slice Master Triumph Eggplant Black Beauty Black Bell Ichiban Endive Green Curled Kale Dw. Blue Curled Vates Dwarf Green Curled Kohlrabi Early White Vienna Early Purple Vienna Leek American Flag Lettuce: Head Great Lakes Mesa 659 Lettuce Leaf Bibb Black Seeded Simpson Buttercrunch Dark Green Boston Grand Rapids Oakleaf Parris Island Cos Prizehead	Romaine Ruby Salad Bowl Valmaine Cos Mustard Florida Broadleaf Green Wave So. Giant Curled Tendergreen Okra Clemson Spineless Dw. Green Long Pod Onion Crystal Wax Bermuda Fiesta Southport Wh. Globe Wh. Sweet Spanish Yel. Sweet Spanish Parsnips All American Harris Early Model Hollow Crown Pea Dwarf Gray Sugar Laxton's Progress Little Marvel Sugar Snap Telephone Thomas Laxton Wando Pepper Anaheim (chili) Bell Boy Big Bertha Calif. Wonder Cherry Sweet Cubanella Gypsy Hungarian Wax	Jalapeno (chili) Keystone Resist. Gt. Long Red Cayenne Pimento Red Cherry (hot) Sweet Banana Yolo Wonder Potato Kennebec Red Pontiac Pumpkin Connecticut Field Jack-O'Lantern Small Sugar Radish Champion Cherry Belle Early Scarlet Globe White Icicle Rhubarb Victoria Rutabaga Amer. Purple Top Salsify Mammoth Sandwich Is. Spinach Bloomsdale Long Stand. Hybrid No. 7 Melody New Zealand Winter Bloomsdale Squash: Summer Cocozelle (zucchini) Ear. Sum. Gold. Crookneck Ear. Prolif. Straightneck Patty Pan Green Tint Scallopini Seneca (zucchini) Ear. Wh. Bush Scallop	Squash: Winter Acorn Buttercup Butternut Hubbard Pink Banana Jumbo Turk's Turban Vegetable Spaghet Tomato Ace Early Cascade Early Girl Patio Red Cherry Roma San Marzano Small Fry Spring Giant Sweet 100 Tiny Tim Yellow Pear Yellow Plum Turnip Pur. Top Wh. Globe Watermelon Charleston Gray Dixie Queen Jubilee Klondike Striped Sugar Baby
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Richter Memorial Library has a more extensive listing of varieties and companies that offer them, also a large collection of seed catalogs.

Desert Gardening Timetable

VEGETABLE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
ARTICHOKE: GLOBE												
ARTICHOKE: JERUSALEM												
ASPARAGUS												
BEAN: SNAP												
BEAN: LIMA												
BEAN: PINTO												
BEET												
BLACK-EYED PEA												
BROCCOLI (PLANTS)												
BRUSSELS SPROUTS (PLANTS)												
CABBAGE												
CABBAGE: CHINESE												
CANTALOUPE												
CARROT												
CAULIFLOWER (PLANTS)												
CELERY												
CHARD												
COLLARD												
CORN: SWEET												
CUCUMBER												
EGGPLANT (PLANTS)												
ENDIVE												
JICAMA												
KALE												
KOHLRABI												
LETTUCE: HEAD												
LETTUCE: LEAF												
LEEK												
MUSTARD												
OKRA												
ONION: GREEN												
ONION: DRY												
PARSNIP												
PEA												
PEANUT												
PEPPER (PLANTS)												
POTATO												
PUMPKIN												
RADISH												
RUTABAGA												
SPINACH												
SQUASH: SUMMER												
SQUASH: WINTER												
SUNFLOWER												
SWEET POTATO												
TOMATO (PLANTS)												
TURNIP												
WATERMELON												

Annual Corporate Members

The Desert Botanical Garden, founded in 1937, is a privately funded, nonprofit institution. Nearly all of our operating expenses are offset with income earned from admissions, Garden memberships and Gift Shop sales. However, for capital improvements, construction of exhibits, expansion of programs and research studies we depend on donations from individuals and corporations.

The local business sector has acknowledged the value of the Desert Botanical Garden as an important community resource by providing annual corporate support. We would like to thank the following companies for their contribution to the Garden this year:

Anchor National Life Insurance Company
Arthur Andersen and Company
The Arizona Bank
Arizona Cactus Sales, Inc.
Arizona Public Service Company
The Arizona Republic/
The Phoenix Gazette
Bayless Markets
Callahan Mining Corporation
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Sun State Savings and Loan
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Valley National Bank
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For more information about our Corporate Membership program and how it can benefit your company, please contact the Community Relations Department.



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